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A LABORATORY EVALUATION OF CONCRETE PATCHING MATERIALS

MATERIALS INFORMATION

ENGINEERING MATERIALS OFFICE

LABORATORY EVALUATION OF

CONCRETE PATCHING MATERIALS

by

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1) INTRODUCTION

In recent years the Concrete Section has received numerous requests from Regional staff, to provide information and recommendations on proprietary concrete patching materials.

This project evaluates 24 patching materials which are available for use in Ontario. The tests used to evaluate the products are described and the test results are tabulated. The materials were evaluated for working time, strength, durability, bond, permeability absorption and shrinkage.

The report lists those materials which appear to be best suited for general repair, and repair which require high early strength, self levelling material, or slurry coats.

2) MATERIALS TESTED

Twenty-four materials were tested, including an air-entrained mortar mix and a latex modified mortar mix.

The basic ingredients of most of the patching materials, except for set 45 and Pre-Krete FS-16, are portland cement with special additives or modifier. Set 45 is a magnesium phosphate and Pre-Krete is a calcium aluminate.

The mortar mix proportions were:

Cement	11.7 kg
Sand	42.9 kg
Water	5.5 kg

Effective w/c = 0.35

The latex modified mix proportions were:

Cement	6.0 kg
Sand	24.0 kg
Water	added as required (approximately 1.5 kg)
Latex	2.0 kg

Effective w/c = 0.32

The latex was chosen from the Designated Sources List for latex suppliers, DS.100.3.

Table 1 summarizes the main ingredients and the mix proportions recommended by the manufacturer. The mix proportions used in the laboratory are written in brackets, if they differed from the manufacturer's mix proportions.

TABLE 1

MIX DESIGN, MAIN INGREDIENTS

PRODUCT	MAIN INGREDIENTS	MIX PROPORTIONS (used in testing)
FS-16 PREKRETE	- calcium aluminate	50 lbs. to 6.25 lbs. water
SET INSTANT	- portland cement	50 lbs. to 6.50 pints (U.S.) water
SIKA 111	- portland cement - liquid polymer	7.2 : 1 by mass, material to polymer
SIKA 121	- portland cement - liquid polymer	5.5 : 1 by mass, material to polymer
SIKA 122	- portland cement - liquid polymer	7.2 : 1 by mass, material to polymer
POLY-REPAIR-IT	- portland cement	3-4 : 1 by volume, material to water (3.5:1)
QUICK-SET	- portland cement	3-4 : 1 by volume, material to water (3.5:1)
EMACO S66	- portland cement	- varies according to weather (55 lbs to 1.9 L water)
EMACO S88	- portland cement	- varies according to weather (55 lbs to 3.28 L water)
CELTITE 10-20	- portland cement - co-polymer	- 1 bag material to 1 bottle polymer (56.8 lbs to 8.1 lbs polymer)*
CELTITE 10-24	- portland cement - co-polymer	- 1 bag material to 1 bottle polymer (61.8 lbs to 6.3 lbs polymer)*
CELTITE 10-22	- portland cement - co-polymer	- 1 bag material to 1 bottle polymer (38.2 lbs to 8.3 lbs polymer)*
SPEED CRETE	- portland cement	- 50 lbs. to 5 qts. water
ROADPATCH	- portland cement - acrylic	- 50 lbs. to 1 U.S. gallon water and acryl bond in a 1:2 ratio by weight

* the masses are the actual masses of the bag of material and the bottle of polymer.

TABLE 1 - Continued

PRODUCT	MAIN INGREDIENTS	MIX DESIGN (used in testing)
MASTERPATCH 10	- portland cement	- 1 bag to 2.5 L water (25 kg to 2.5L)
MASTERPATCH 20	- portland cement	- 1 bag to 2.3 L water (25 kg to 2.3 L)
VERTIPATCH	- portland cement	- varies according to the weather - (50 lbs to 2 L water and 2 L acryl)
CELROC 10-60	- portland cement	- 50 lbs to 5-1/2 U.S. pints water
MTC MORTAR MIX	- portland cement	- see previous page
SIKATOP 123	- portland cement - liquid polymer	- 1:5 by mass, material:polymer
LATEX MODIFIED MORTAR MIX	- portland cement - latex	- see previous page
SET 45	- magnesium phosphate	- 50 lbs to 1/2 U.S. gallon water
TAPE CRETE	- portland cement	- varies according to cement type) (75 lbs:4:25 lbs:23.25 lbs cement:water:polymer)
DUROCRETE	- portland cement	- 3.5-4 L water: 1 bag (3.5 L to 22.2 kg)

3) TEST PROCEDURES

The patching materials were tested for:

1) salt-scaling resistance
2) compressive strength
3) chloride permeability
4) length change
5) slant shear strength
6) water absorption

The approximate working time was observed during the testing and temperature of the material were taken during setting.

All tests are based upon various ASTM, AASHTO, or MTC procedures. Changes were made so that the products were treated as they would be in the field. This included compaction by hand, hand mixing or mixing in a mortar mixer, and curing as per the manufacturer's recommendations.

Details of all the test methods appear in Appendix 'A'.

3-1 Curing

When the manufacturer recommended that no curing was required unless it was very hot and dry or windy the specimens were stored at normal laboratory temperature and humidity. If the manufacturer required damp curing then the materials were placed in the moist room for 24 hours. No curing compounds were used.

The MTC mortar mix was cured for three days in the moisture room followed by storage at normal laboratory temperature and humidity conditions.

3-2 Preparation of the Specimens

The materials were mixed by hand in small batches if they set in less than fifteen minutes. The other products were mixed in the 50 L Hobard mixer at 61 rpm.

The materials were placed in the moulds in two layers and were compacted by hand, except for the slant shear specimens which were rodded.

The temperature of the laboratory room was 23° ± 2°C, the water or polymers used for mixing were at room temperature and the relative humidity was 40±2%.

All of the moulds were coated with silicone to allow for easy removal.

Table 2 indicates the type of curing and the observed working time.

TABLE 2

CURING PROCEDURES, OBSERVED WORKING TIMES,

AND LABORATORY STAFF COMMENTS

PRODUCT NAME	CURING PROCEDURES (DURING TESTING)	OBSERVED WORKING TIME (MIN)	LABORATORY STAFF COMMENTS
FS-16 PREKRETE	-In lab. air	8	-very dry mix
SET INSTANT	-In lab. air	35	
SIKATOP 111	-In lab. air	20	-strong odour
SIKATOP 121	-In lab. air	70	-does not finish well, strong odour
SIKATOP 122	-In lab. air	100	-strong odour
POLY-REPAIR-IT	-In lab. air	15	-stiff mix, difficulty in finishing
QUICK-SET	-In lab. air	7	
EMACO S-66	-24 hrs. moisture room	20	-difficult to mix by hand
EMACO S-88	-24 hrs. moisture room	60	-difficult to mix by hand
CELTITE 10-20	-In lab. air	10	-slightly dry mix
CELTITE 10-24	-In lab. air	15	
CELTITE 10-22	-In lab. air	30	-no adherence overhead
SPEEDCRETE	-In lab. air	10	-material drags when finished
ROADPATCH	-In lab. air	30	-contains 1" fibreglass pieces
MASTERPATCH 10	-24 hrs. moisture room	5	-rough finish
MASTERPATCH 20	-24 hrs. moisture room	15	-difficult to finish
VERTIPATCH	-24 hrs. moisture room	15	
CEL-ROC10-60	-In lab. air	10	
MTC MORTAR MIX	-3 days moisture room	30	-dry mix
SIKA 123	-In lab. air	15	
MTC LATEX MODIFIED MORTAR MIX	-24 hrs. moisture room	60	
DUROCRETE	-In lab. air	7	
SET 45	-In lab. air	10	-becomes very hot during setting
TAPE CRETE	-In lab. air	-	-poor finishing

4) TEST RESULTS

4-1 Salt Scaling Acceptance

The allowable loss for pre-cast units is 0.800 kg/m^2 after 50 cycles of freezing and thawing. This limit has been applied to the concrete patching materials.

Three products failed this test and they went over the 0.800 kg/m^2 limit in the first 10 cycles.

The biggest problem with this test was the leaking of some of the slabs. The two Emaco products and Poly-Repair-It slabs had dykes that cracked and had to be repaired 3 times each during the course of the test. This may have been due to the products expanding during the test. The Sikatop 123 became completely detached from the concrete base and was epoxied back on to the slab.

4-2 Compressive Strength

Five sets of three 50 mm cubes were made for these tests. When the test was first designed the strengths were to be taken at 2 hrs, 4 hrs, 24 hrs, 3 days, and 28 days, but it became apparent that many products had no appreciable strength at 2 and 4 hours and they could easily be broken by hand. These materials were then tested at 2 days and seven days. Table 3 summarizes the compressive strengths.

Materials which reach a strength of 8 MPa at 4 hrs are considered to have high-early strength. Materials which have a strength of 30 MPa at 28 days are classified as high strength.

4-3 Slant Shear Bond

The allowable minimum shear strength is 6 MPa. This is based on the 5.2 MPa 28 day result of the MTC mortar mix. The majority of products obtained this minimum strength. There were 3 materials which had no bond strength at all. Two specimens fell apart during the capping process. Another product fell apart while the specimen was being lifted.

4-4 Absorption

The absorption rate of the MTC mortar was 6.55%, for this reason the allowable absorption is considered to be 6.5%. The results of the test varied a great deal from 18.9% to less than 1.0% for the latex modified mortar mix.

During the project the specimens were tested at 48 hours, in future this test will be done at 14 days.

4-5 Chloride Permeability

The 'Rapid Chloride Permeability Test' measures the chloride permeability as the total charge which is allowed to pass through a 50 mm thick 96 mm diameter, cylinder of the patching material.

The more chloride ions which penetrate the material the higher the total charge. A charge of 4000 coulombs and above is considered a high permeability.

It was thought that there would be a relationship between the absorption and chloride permeability results. Although most materials which had high absorption had a high permeability, this was not always the case. This was most likely due to the two different ages at which the testing took place.

4-6 Length Change

The materials tested had shrinkages varying from 0.053% to 0.279% at 60 days. The mortar mix shrinkage was 0.097%.

4-7 Working Time

The length of time that a product was workable was observed by the laboratory staff. This was not a test only an observation. The list of recommended products indicates the working time as less than or greater than 15 minutes.

The working time will vary greatly with the temperature of the air and the mixing water. The air temperature was 23°C ± 2° during the testing, the water was kept at room temperature.

4-8 Overhead Bond Strength

We attempted to apply the materials (only those recommended for overhead repairs) to a concrete slab which was in a overhead position but could not get a good bond with any of the products. Most would not adhere to the slabs, others only in very thin layers.

Any reference made to the use of materials for repairing overhead work is based only on the manufacturer's literature.

Table 4 is a summary of all the test results.

TABLE 3
COMPRESSIVE STRENGTH (50 mm CUBES)

LAB NO.	COMPRESSIVE STRENGTH (MPa)							
	2 HRS.	4 HRS.	6 HRS.	24 HRS.	2 DAYS	3 DAYS	7 DAYS	28 DAYS
MTC MORTAR				12.27	19.41	27.0	32.92	38.89
MTC LATEX MODIFIED MORTAR				7.44		20.13	27.17	31.20
FS-16 PREKRETE	6.53	9.19		13.82		19.75		29.50
SET INSTANT	3.77	4.20		21.22		32.83		40.24
SIKATOP 111			0.24	6.14	24.83	30.94		49.91
SIKATOP 121			1.31	6.24	20.89	24.56	32.65	46.98
SIKATOP 122			1.52	8.94	24.06	26.32		43.01
POLY-REPAIR-IT	1.06	1.74		23.73		33.10		37.30
QUICK SET	0.36	0.78		13.74		21.11		27.26
EMACO S66				24.26	47.53	54.51	61.24	53.81
EMACO S88				22.78	40.98	46.78	56.20	64.26
CELTITE 10-20				14.53	21.65	23.24	31.86	38.39
CELTITE 10-22				4.91	8.79	10.27	9.66	16.78
CELTITE 10-24				35.08	42.07	44.15	48.24	52.35
SPEEDCRETE		1.28		14.01		23.32	26.76	23.37
ROAD PATCH		8.11		18.05		26.62		43.68
MASTERPATCH 10	2.98	5.74		23.78		37.40		48.13
MASTERPATCH 20				40.13	49.55	48.55	48.52	62.83
VERTIPATCH	0.60			22.38	28.8	34.2		44.20
CELROC 10-60	18.44	33.01		41.01		60.61		67.57
SIKATOP 123	7.94	8.16		23.2	27.39	29.33		46.48
DUROCRETE	3.46	4.04		5.79		19.04		26.19
TAPECRETE				20.64	35.32		43.47	54.58
SET 45	35.18	43.95		33.04		53.97		52.09

TABLE 4 - TEST RESULTS

LAB NO.	SLANT SHEAR STRENGTH MPa		ABSORPTION (%)	CHLORIDE PERMEABILITY (COULOMBS)	SHRINKAGE (%)	SALT SCALING (kg/m^2)
	24 HRS.	28 DAYS				
MTC MORTAR MIX	2.8	5.2	6.55	8354 (high)	0.097	0.240
MTC LATEX MODIFIED MORTAR	2.0	8.6	0.63	1480 (low)	0.086	0.134
FS-16 PREKRETE	2.4	0.0	10.48	3 523 (moderate)	0.177	1.736 (10 cycles)
SET-INSTANT	6.4	8.9	8.20	4992 (high)	0.065	0.104
SIKATOP 111	5.3	17.2	1.81	599 (very low)	0.147	0.332
SIKATOP 121	2.7	7.2	2.61	3125 (moderate)	0.279	0.200
SIKATOP 122	4.8	6.4	1.51	1174 (low)	0.212	0.510
POLY-REPAIR-IT	4.2	(fell apart capping)	14.62	no material	0.265	0.107
QUICK-SET	2.3	(fell apart capping)	16.27	no material	0.249	0.092
EMACO S66	7.4	21.4	2.89	376 (very low)	0.078	0.183
EMACO S88	4.6	10.3	4.94	716 (very low)	0.130	0.262
CELTITE 10-20	0.9	3.1	1.96	809 (very low)	0.088	0.237
CELTITE 10-24	4.7	9.9	1.53	685 (very low)	0.053	0.189
CELTITE 10-22	0.5 bonding agent used	3.5	4.09	615 (very low)	0.100	0.167
SPEEDCRETE	2.4	1.0	18.95	5241 (high)	0.204	0.129
ROADPATCH	4.0	7.9	8.13	1190 (low)	0.100	3.823 (20 cycles)
MASTERPATCH 10	6.5	10.7	6.63	1418 (low	0.112	Not Tested
MASTERPATCH 20	11.6	10.5	2.97	2460 (moderate)	0.075	0.160
VERTIPATCH	4.9	6.8	3.68	4295 (high)	0.155	0.242
CELROC 10-60	6.8	18.4	2.59	57 (negligible)	0.100	0.709
SIKATOP 123	5.8	6.6	2.20	1217 (low)	0.265	0.710
DUROCRETE	1.4	2.4	10.9	7773 (high)	0.271	1.405
TAPECRETE	9.8	12.3	4.86	1416 (low)	0.185	0.164
SET 45	17.1	21.4	7.39	619 (very low)	0.028	0.423

5) RECOMMENDATIONS

Only products which passed the chloride permeability test, had a good 28 day slant shear bond strength and scaled less than 0.800 kg/m^2 during the freeze-thaw salt scaling test were included in the list of recommended products.

The materials have been placed in one of four categories.

1) General Repairs - These materials do not fit the other three categories but are suitable for repair work. See Table 5.

2) High Early Strength - These materials have a compressive strength of 8 MPa at 4 hrs. See Table 6.

3) Self-Levelling - These materials are very flowable and will spread out to fill a cavity. They are used on horizontal surfaces and are useful for hard to reach areas. See Table 7.

4) Slurry Coats - These materials are to be used for very thin repairs or for coatings. See Table 8.

Emaco S-66, Celtite 10-24, Masterpatch 20, Celroc 10-60, Set 45 and the MTC Latex Modified Mortar all did well in the testing but they are not, according to the manufacturer's literature, recommended for overhead work* and only Emaco S-66 is recommended for vertical repair work. The low 24 hour bond strength of the Latex Mortar and the high absorption of Set 45 are not significant problems.

The Sikatop 122 and 123 exhibited a high shrinkage during the testing but have been included in the list because all are recommended for vertical and overhead repair work. Emaco S-88 and Sika 111 also have a high shrinkage but are the only two products which are self-levelling. Sika 121 and Tapecrete also exhibit a high shrinkage but are the only slurry coat products. Celtite 10-20 performed well in all tests but had a low 28 day shear bond strength.

Vertipatch and Set Instant can be used in areas free from salt. Masterpatch 10 was not tested for freeze/thaw scaling resistance as it is not recommended for use in areas where deicing salt is used, but it may be used in salt free areas.

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*overhead work refers to work in an overhead position without the use of forms.

CONCRETE PATCHING MATERIALS - GENERAL REPAIRS									
PRODUCT	APPLICATIONS*			HIGH-EARLY STRENGTH (1)	HIGH STRENGTH (2)	WORKING TIME		AGGREGATES (3)	LIMITATIONS
	O.H.	V	H			<15 min.	>15 min.		
EMACO S-66		X	X		X		X		- must use mortar mixer, dark grey - minimum thickness is 100 mm
CELTITE 10-24 (P)			X		X	X			- minimum thickness is 13 mm
MASTERPATCH 20			X		X	X			- for repairs between 25 mm - 200 mm
SIKATOP 122	X	X	X		X		X		- minimum thickness is 3 mm - very high shrinkage
MTC LATEX (P) (4) MODIFIED MORTAR			X		X		X	X	

(P) a polymer or latex is added instead of or with water.
* OH - overhead, V - vertical, H - horizontal (based upon the manufacturer's literature)
(1) high-early strength >8 MPa at 4 hours.
(2) high strength >30 MPa at 28 days.
(3) aggregates can be added to extend the mix.
(4) the latex must be chosen from DS 100.3

TABLE 5

CONCRETE PATCHING MATERIALS - HIGH EARLY STRENGTH - products reach 8 MPa at 4 hours									
PRODUCT	APPLICATIONS*			HIGH-EARLY STRENGTH (1)	HIGH STRENGTH (2)	WORKING TIME		AGGREGATES (3)	LIMITATIONS
	O.H.	V	H			<15 min.	>15 min.		
CELTITE 10-60			X	X	X	X		X	- minimum thickness is 13 mm
SIKATOP 123 (P)	X	X	X	X	X	X			- for repairs between 13 mm - 38 mm - very high shrinkage
SET 45			X	X	X	X		X	- minimum thickness of 13 mm. - dark grey colour

(P) a polymer or latex is added instead of or with water.
* OH - overhead, V - vertical, H - horizontal (based upon the manufacturer's literature)
(1) high-early strength >8 MPa at 4 hours.
(2) high strength >30 MPa at 28 days.
(3) aggregates can be added to extend the mix.

TABLE 6

CONCRETE PATCHING MATERIALS - SELF-LEVELLING
- products will flow into hard to reach areas and self-level

PRODUCT	APPLICATIONS*			HIGH-EARLY STRENGTH (1)	HIGH STRENGTH (2)	WORKING TIME		AGGREGATES (3)	LIMITATIONS
	O.H.	V	H			<15 min.	>15 min.		
SIKATOP 111			X		X		X	X	- will not self level with aggregates - high shrinkage
EMACO S-88			X	X	X		X		- must use mortar mixer - maximum thickness is 100 mm - dark grey - high shrinkage

(P) a polymer or latex is added instead of or with water.
* OH - overhead, V - vertical, H - horizontal (based upon the manufacturer's literature)
(1) high-early strength >8 MPa at 4 hours.
(2) high strength >30 MPa at 28 days.
(3) aggregates can be added to extend the mix.

TABLE 7

CONCRETE PATCHING MATERIALS - SLURRY COATS
- for thin coats only

PRODUCT	APPLICATIONS*			HIGH-EARLY STRENGTH (1)	HIGH STRENGTH (2)	WORKING TIME		AGGREGATES (3)	LIMITATIONS
	O.H.	V	H			<15 min.	>15 min.		
SIKATOP 121	X	X	X		X		X		- maximum thickness is 3 mm - very high shrinkage
TAPECRETE		X	X	X	X	X			- high shrinkage

(P) a polymer or latex is added instead of or with water.
* OH - overhead, V - vertical, H - horizontal (based upon the manufacturer's literature)
(1) high-early strength >8 MPa at 4 hours.
(2) high strength >30 MPa at 28 days.
(3) aggregates can be added to extend the mix.

TABLE 8

6) GUIDELINES WHEN USING PATCHING MATERIALS

6.1) The preparation of the repair area.

A) Chip out all the deteriorated concrete, chip 25 mm below reinforcement that is 50% exposed or debonded. Chip along reinforcement until it is free of heavy rust.

B) Sawcut the perimeters of the repair area if it is deeper than 12 mm, or follow the manufacturers recommendations.

C) Sandblast the area to be repaired and air blast to remove dust and sand. (Sandblasting may not be required with all products).

D) Check to make sure that all of the loose concrete have been removed.

E) Follow the manufacturer's directions concerning the coating of the concrete surface, most require a wet surface, some a dry surface and a few require a bond coat.

6-2) Always follow the manufacturers direction concerning the mixing time and mix proportions.

Almost all materials allow no retempering.

All materials can be mixed in a mortar mixer and many can be mixed by hand.

Using the working time as a guide to determine the amount of material that should be mixed. The working time decreases with increasing temperature.

6-3) Always follow the manufacturer directions for curing procedures.

6-4) Always read the manufacturer's literature before using a patching material, if there are any inquiries, contact the manufacturer directly.

6-5) Form work can be used with some materials for vertical and overhead applications, consult the manufacturer for advice in this matter.

APPENDIX A

TEST PROCEDURES

TEST PROCEDURES

1) General Information

A) The concrete mix to be used for the bases in the shear bond and the salt scaling acceptance tests is a MTC Laboratory standard 30 MPa mix with a slump of 80 mm ± 10 mm and an entrained air content of 6% ± 1%. The mix will contain WRDA water reducer and Darex air entraining agent.

B) Constant weight is considered to be reached when

"the difference between any two successive weights in less than 0.5% of the lowest weight obtained" (ASTM C642-81 Section 4.1).

C) All materials are to be mixed and cured as per the manufacturer directions (see Section 3) at standard laboratory temperature and humidity.

D) Finish the specimens with a wooden or steel trowel.

E) All moulds should be coated with silicone to allow for easy removal of the specimen. Remove all specimens from the moulds at 24 hours unless otherwise stated.

2) Working Time

The working time is defined as the length of time that a product can be worked before it starts setting. It is observed to the nearest 5 minutes.

The temperature of the material is taken every minute for the first five minutes then at seven minutes then at every 5 minute intervals until the material sets.

The data is recorded on the attached sheet.

LAB. NO.: _____

DATE OF TEST: _____

TEMPERATURE OF PATCHING MATERIAL

PRODUCT: _____ ROOM TEMPERATURE: _____

READINGS

INITIAL

extra readings required

1 minute _____

2 minutes _____

3 minutes _____

4 minutes _____

5 minutes _____

7 minutes _____

10 minutes _____

15 minutes _____

20 minutes _____

MIX DESIGN:

OBSERVED WORKING TIME:

- record temperature until setting or room temperature is reached.

3) Chloride Permeability

A) Prepare one 96 mm diameter x 50 mm cylinder of the patching material.

B) Cure the specimen.

C) Allow the material to age 14 days.

D) Determine the Chloride Permeability as per AASHTO T-277-831 -- Rapid Determination of the Chloride Permeability of Concrete on the specimen.

E) Record on attached sheet.

Product:

Date of Test:

Mix Design: _____

Mix Temp.: _____

Water Temp.: _____

Curing: _____

Results: (Attach read out tape)

(+1) = Time (minutes)

(+2) = Current (amps)

(+3) = Charge (coulombs)

Error of Permeability Cell:
(determined using 100 Watt
light bulb)

Comments:

4) Length Change

Test the patching material as outlined in ASTM C157-80 -- Length Change of Hardened Cement Mortar and Concrete with the following changes.

A) Measure the length change at 24 hours, 3 days, 28 days, and at 60 days from the day of casting.

B) Cure the specimens as previously described, then store at standard laboratory temperature and humidity.

C) Record on the attached sheet.

LAB. NO.: _____

DATE OF TEST: _____

LENGTH CHANGE

PRODUCT: CURING:

INITIAL OBSERVATIONS:

LENGTH MEASUREMENTS

	1 DAY	3 DAYS	28 DAYS	60 DAYS	% CHANGE IN LENGTH
SPECIMEN ____ - 1					
SPECIMEN ____ - 2					
SPECIMEN ____ - 3					
				AVG. % CHANGE IN LENGTH	

$$\% \text{ CHANGE IN LENGTH} = \frac{\text{INITIAL LENGTH} - \text{28 DAY LENGTH}}{\text{EFFECTIVE LENGTH}} \times 100$$

MIX PROPORTIONS:

* ROOM TEMPERATURE

COMMENTS:

* temperature at time of mixing

5) Compressive Strength

A) Prepare fifteen 50 mm cubes of the patching material.

B) Place the patching material into the moulds in 3 layers, making sure that the material is compacted well into the corners of the moulds. (If the patching material sets very quickly place it in 2 layers).

C) Finish and cure the specimen as previously described.

D) Test the specimens in groups of 3 at 2 hours, 4 hours, 24 hours, 3 days and 28 days. If the material has no strength at 2 hours or 4 hours (i.e. it can easily be broken by hand) then test at 6 hours or 2 days and at 7 days. Use equipment as described in CAN 3 ASM77 (7.5.3.1 part A).

E) Record on the attached sheet.

LAB. NO.: _____

DATE OF TEST: _____

COMPRESSIVE STRENGTH TEST

PRODUCT: CURING:

COMPRESSIVE STRENGTHS

	2 HOURS	4 HOURS	24 HOURS	3 DAYS	28 DAYS
AVERAGE					

MIX PROPORTIONS:

* ROOM TEMPERATURE

COMMENTS:

* TEMPERATURE TAKEN AT TIME OF MIXING

6) Shear Bond Strength

A) Make 6 - 100 mm cylinders of 30 MPa concrete.

B) The cylinder will be cured for 14 days in the moisture room and 14 days at standard laboratory temperature and humidity.

C) Cut the cylinders at the angle shown in ASTM C822-78, Bond Strength of Epoxy-Resin Systems used with Concrete.

D) Coat the 100 mm cylinder moulds with silicone and place the bottom half of the cut cylinders into the mould.

E) Prepare the surface of the concrete cylinder as per the manufacturer directions. Do not sandblast the surface.

F) Prepare the patching material as per the manufacturer's instructions.

G) Place the patching material into the moulds in 2 layers, rodding each layer at least 5 times. (The stiffer materials may require more rodding but they also tend to set much faster).

H) Tap the outside of the cylinder.

I) Cure the cylinder as per previous instruction.

J) Test 3 cylinders in compression at 24 hours and 3 in compression at 28 days. Remove all cylinders from the moulds at 24 hours, as described in ASTM C882-78 parts 11.2, 11.3.

K) Record on the attached sheet.

LAB. NO.: _____

DATE OF TEST: _____

SHEAR/BOND TEST OF PATCHING MATERIALS

PRODUCT: CURING:

BOND STRENGTHS

24 HOURS		28 DAYS	
STRENGTH	SKETCH	STRENGTH	SKETCH
AVERAGE		AVERAGE	

MIX PROPORATIONS:

* ROOM TEMPERATURE

COMMENTS:

* temperature at time of mixing

7) Salt Scaling

Perform test as outlined in MTC Form 1351.07, Salt Scaling Acceptance Test, with the following exception.

A) Prepare two slabs of 30 MPa, air-entrained concrete (as described previously) of 300 mm x 300 m x 50 mm. Cure the slabs for 14 days moist and 14 days dry. Place a 25 mm layer of the patching material on top of the concrete slab. (The top of the slab must be prepared as described by the manufacturer for placement of the patching material). Cure the patching material as described previously.

B) Store the specimens in standard laboratory conditions for 14 days after casting (or 13 days after moist curing if required). Start the test at 14 days after casting.

C) Record on standard test sheets.

8) Water Absorption

A) Prepare two 150 mm x 150 mm x 50 mm specimens of the patching material.

B) Cure as described previously.

C) Demold at 24 hours.

D) Allow the specimen to age in standard laboratory condition until 14 days after casting.*

E) Dry the specimen at 105°C ± 5°C until constant weight is reached.

F) Allow the specimen to cool to room temperature, weigh the specimen, then submerge it in room temperature water.

G) Let the specimens to soak for 24 hours then remove them, surface dry the specimen with an absorbent cloth and weigh.

H) Calculate the percentage of water absorbed and record on the attached sheet.

* During the testing for this program this test was done when the specimen was 48 hours old this will have to be changed to 14 days.

LAB. NO.: _____

DATE OF TEST: _____

WATER ABSORPTION TEST

PRODUCT: CURING:

MASS OF SAMPLE TILL CONSTANT (grams)

SPECIMEN #1:

SPECIMEN #2:

MASS OF SAMPLES (grams)

AGE (HRS.)	DRY -	2	4	6	24	% ABS.
SPECIMEN #1						
SPECIMEN #2						
					AVERAGE % ABS.	

$$\% \text{ ABSORPTION} = \frac{(\text{MASS OF WET BLOCK AT 24 HOURS}) - (\text{MASS OF DRY BLOCK})}{(\text{MASS OF DRY BLOCK})} \times 100$$

MIX PROPORTIONS:

* ROOM TEMPERATURE

COMMENTS

* temperature at time of mixing

APPENDIX B

NAMES AND ADDRESSES

LIST OF ADDRESSES

SIKA PRODUCTS
SIKATOP 122, 123, 121, 111

Sika Canada Inc.
7270 Torbram Rd.
Suite 204
Mississauga, Ontario
L4T 3Y7
Charles Kidd (416) 678-2843

SET PRODUCTS
SET-45

Mappe Products
225 Morrish Rd.
West Hill, Ontario
M1C 1E9
Ronald Rumble (416) 281-2171
(Res.) (416) 822-2468

CELTITE PRODUCTS
CELTITE 10-20, 10-22
10-24, 10-60

Paul W. Tomkinson
(519) 833-9846

MASTER BUILDERS PRODUCTS
MASTERPATCH 20
SET 45

Suite 100
35 Oak St.
Weston, Ontario
John Smolyn (416) 247-7135

MAC PRODUCTS
EMACO S88, S66

Modern Advanced Concrete
53 Widdicombe Hill Blvd.
Suite 901
Weston, Ontario
Al Klassen (416) 245-8703

TAPE CRETE

FRC Composites Ltd.
1993 Leslie St.
Toronto, Ontario
M3P 2M3
Alan Karuks (416) 449-1405